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ABSTRACT

The slow learner is defined as a student whose IQ falls between 75 and 90 or who ranks below the thirtieth percentile of the student population in mathematical achievement. His characteristics and special needs are discussed in some detail. A presentation of selected methods and techniques for instructing slow learners to add and subtract non-decimal fractions follows. Behavioral objectives, specific topics, and an estimated schedule are given. Resources required for this instruction are described. The strategy employs concrete examples to the maximum extent possible. The laboratory approach and discovery methods are recommended. The nature and use of a particular teaching aid are discussed. The emphasis in evaluation is on each student's progress. (KM)

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The Teaching of Addition and Subtraction of Non-Decimal Fractions to Low Phase Secondary School Students

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Outline

Thesis: In the education of our young people, perhaps the single most important objective is to prepare the student for living successfully in today's society. The ever increasing complexity of our society places a greater learning load on each succeeding generation of students. A significant segment of each generation of students is comprised of pupils who cannot keep pace with their classmates. They are known as the slow learners and their academic experience generally starts out badly in the first grade and continues to worsen as the years go by until they either drop out of school or barely get through to graduation. In either case, they enter adult society with inadequate or marginal capabilities to become successful and contributing citizens. These slow learners pose one of the public school systems' greatest problems and challenges today. To successfully teach slow learners, an educator must understand as much as possible about them, must appreciate their many problems and must know how best to motivate them to learn. The slow learner entering junior high school generally has difficulty with all subjects, but especially with mathematics. The ability to deal with fractions has proven to be one

of their biggest obstacles (9).* The purpose of this paper is to examine the slow learners in junior high school and to research and present selected methods and techniques for instructing them to successfully add and subtract non-decimal fractions.

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The Teaching of Addition and Subtraction of Non-decimal Fractions to Low Phase Secondary School Students

A nation wide testing program has recently been conducted in the United States to evaluate the general quality of public education. Four major testing companies, approved by the federal government, administered the tests and preliminary results are beginning to appear. A general decline in scores has been noted as compared to previous national testing with the most significant drop occuring in the area of mathematics (21). Further testing of students by the State of Florida in the area of mathematics indicates that 50 per cent of the young people now entering 9th grade are low achieving students (9). While these facts are by no means conclusive, they do suggest that a challenging educational problem exists and that the prognosis today is not upward.

Educators throughout the world are constantly striving to improve the quality of education and thus produce an adult population of <u>whole persons</u>, ready to take their proper places in today's society. The factors which determine the quality of education are so numerous and so complex that it should be no surprise that progress comes quite slowly in attaining any significant improvements. Quality of teachers, students and curriculum are three major areas

of consideration in achieving better education. Deficiencies in any of these areas will seriously reduce the quality of the learning outcome, however, wealness in one area can often be compensated for by increased strength in the remaining areas. In this paper, an attempt will be made to identify and develop sufficiently strong teaching methods to partially offset the learning deficiency associated with the low achieving student.

Failure of a student to attain normal achievement in school can stem from many causes. Bad health, physical handicaps, poor home environment, frequent family moves, mental retardation are but a few causes that relate to the student. Others, such as overcrowded schools, minority discrimination, ineffective teachers and inadequate education facilities can also lead to low achievement. The total list of causes could continue on and on. In this paper, I will limit my considerations of low achieving students to that category known as the slow learner. These students are present in all public schools across our nation in sufficient numbers to constitute a major problem.

Numerous terms have been used by various groups when referring to individuals with less than normal intelligence. Terms such as slow learners and mentally handicapped have sometimes been used interchangeably. They have been used by some people as descriptive

terms and by others to refer to specific groups with restricted degrees of mental retardation. Often, clinical psychologists and teachers, when talking with parents, use the term slow learner when actually referring to marked degrees of mental retardation to soften the impact of the diagnosis. The term slow learner is obviously more socially acceptable than such terms as mentally deficient or feebleminded. There is no universally accepted terminology to differentiate the various degrees of mental retardation, however, certain terms have gradually come to have relatively broad acceptance by substantial numbers of educators. For the purposes of this paper, these most common educationally accepted terms will be used(15).

The term mentally retarded is ordinarily used descriptively to include all children with any significant degree of mental retardation. As a result, it gives no specific indication of the individual's potential or level of academic ability. It includes children with mental ability from a level so low that no academic skills can be learned to levels approaching normalcy allowing the individual to potentially achieve from 6th to 9th grade level. Approximately 20 per cent of the general population has some signicant degree of mental retardation that prohibits them from learning academic skills at the normal rate and to the same degree of understanding

and proficiency that is ordinarily expected from most children. The mentally retarded children can be divided into 3 general categories, the mentally deficient, the mentally handicapped, and the slow learner.

The mentally deficient comprise only 0.5 per cent of the general population and are usually considered uneducable in terms of learning academic skills. They are taught in very small groups in special classes, more often in special schools. They frequently have physical anomalies that also set them apart and usually have poorly developed motor skills as well.

The mentally handicapped comprise 2 to 3 per cent of the general population. Unlike the mentally deficient, they are relatively normal in their physical and motor development. A mentally handicapped child cannot usually be recognized by merely looking at him or her; identification requires psychological diagnosis. The mentally handicapped attain a maximum mental growth of between 7½ and 11 years of age. Their grade achievement should be from 2nd to 4th or 5th grade level. They are educable but only through special classes, so there is little likelihood that they would be found in junior high school.

The slow learners comprise the largest category of mentally retarded persons. Among the general

school population, 15 to 18 per cent of the students can be considered slow learners. Since they comprise a very large group, and since they do not deviate as markedly from the average as do the other groups of mentally retarded children, special educational provisions have only recently been considered essential. These students provide one of the largest and most intense continuing problems facing the general classroom teacher today. They confront every teacher, with the possible exception of those who instruct only advanced academic senior high school subjects.

In an average community where the school serves children from all cultural, social and economic levels, a class of 30 unselected pupils can be expected to contain 4 or 5 slow learners. The incidence of slow learners varies with the type of community. Preferred suburban communities, where executive and professional persons reside, will have very few slow learners. On the other hand, the sub-cultural areas of large metropolitan communities, where the children receive little psycho-social stimulation, present quite a different picture. It is not unusual to find that 50 per cent or more of the students in these communities are slow learners.

The slow learners can basically be defined as those students who are unable to "keep up" with the rest of the class in their rate of academic growth.

For example, they learn to read approximately one year later than the majority of the children. Their rate of reading development is then about 0.8 to 0.9 of a year during each succeeding school year. They are behind at the start and continue to fall farther and farther behind as they grow older. What is true for reading is also true for other skill areas and the content areas as well. The slow learners grasp new skills and concepts more slowly than is expected for their age group. The U. S. Office of Education, in cooperation with the National Council of Teachers of Mathematics, defined the slow learner in mathematics as: "that student who by teacher estimates, achievement tests, or by whatever means the school uses for marking, grouping, or promotion, ranks below the 30th percentile of the student population in achievement in mathematics" (19). The slow learners' maximum mental growth ranges from 11 years to 13 years-6 months. Continually being at the bottom of the class, so discourages them that they generally drop out of school before graduation. Deviate, anti-social and unacceptable behavior is often observed in these students.

The slow learners have always been present with us and likely always will be. The problems resulting from their reduced learning rate and limited level of intellectual development however, depend

largely upon the demands imposed on them by society. The demands placed on the slow learners by early American society were not great and slow learners have not always posed an educational problem in the American public schools. In fact, the major problem only dates from about the beginning of the 20th century.

The education of the Colonial and post Revolutionary War periods offered few student opportunities. The majority of people received no schooling or at most, sporadic attendance for short periods of time. Available funds were small, teachers were poorly trained and text books and materials were extremely inacequate. The responsibility for education rested on the individual family or in some cases the local community. The character of these early American schools varied widely, but almost all of them had as their primary purpose the preparation of the student to enter college. The Latin Grammar School provided such preparation by concentrating on the teaching of Latin, English and Mathematics. With a growing trend toward industry and commerce in the early 1800s, the American populace demanded a broader curriculum. The Latin Grammar School was unable to adjust to these demands and was largely replaced by the academy (15). The academies, for the most part, were local, independent institutions

unsupervised by state regulations. They were designed to meet the needs of the large and growing middle class. Their primary purpose was to prepare students to take their places directly in trade and commerce with a lesser emphasis on college preparation. They offered a broader choice of subjects, made provisions for girls and in general, greatly broadened this country's education programs and opportunities. As our nation became more industrialized, its people left the rural agrarian life and entered the urban factory and commerce environment. As the 19th century drew to a close, the American middle class society was prosperous and much more aware of the importance of education to a successful life. The academies, with their private controls and charging tuition, were gradually replaced by publicly controlled and supported high schools.

Some important movements in the social areas began to evolve in this country in the late 1800s. Probably the most important one, from an educational point of view, was a growing national feeling of social responsibility for children. This resulted in a number of legislative acts that promoted the development and expansion of education. The primary acts were the child labor and the compulsory school attendance laws. The attitude that childhood is a period of growth and development, a time to learn and prepare

to become a citizen who can contribute to the welfare of the society, was reflected in these legislative actions. The compulsory school attendance law brought all children except the mentally deficient into the public schools and required that they remain in school until they reached age 16 (15).

The public school system has grown a great deal in this century and has undergone a number of changes. A major shift in philosophy of education has evolved. Instead of the tightly bound reading, writing and arithmetic curriculum with college readiness as its goal, the new aim of the school is to additionally provide a more socially enriching less disciplined curriculum, preparing the graduate for entry into semi-skilled industry or business. Many new subjects have been introduced in the elementary schools to help the students live more effectively in their social and physical environment. Numerous courses, including vocational ones are now in the secondary schools and graduation requirements have been adjusted to accomodate the students' choice of elective credits. The instruction has become less formal and the sound of the "hickory stick" has all but disappeared. Teachers now have a better understanding of individual student differences through knowledge acquired from child psychology studies. This is not to say

that student discipline is no longer a problem, rather that different control modes are being employed in today's schools.

During the first half of this century, the school years were arranged into 8 years of elementary and 4 years of high school. Then by the middle 1940s, psychological and child development research determined that the preadolescent child has certain problems which are unique and which can be best dealt with in a separate school environment. Thus the school years were redistributed into 3 levels; 6 years of elementary, 3 years of junior high and 3 years of senior high school. Teachers for these newly established junior high schools were obtained in most states by the issuance of junior high school credentials to all teachers previously holding high school teaching certificates. This provided an immediate source of teachers, however, it automatically loaded the junior high school with the characteristics of a senior high school with all its rigidity, emphasis on grade standards and subject matter centered curriculum. This situation was, at best, a compromise in what the psychological studies had prescribed for the preadolescent students.

One final change which occurred in the elementary schools in recent years and which has stirred up much controversy is the policy of social pro-

motion. This is a procedure whereby a student is advanced through the school with his social group. One readily thinks of several advantages and drawbacks in this practice. It has imposed a severe burden on both the students and teachers in the secondary schools where the practice finally reaches its day of reckoning.

As stated earlier, the slow learners have always been with us and probably always will be. Their presence in this country, today creates a most serious problem in our educational system and their numbers increase annually. The school system of colonial times had no slow learner problem at all. Where, then did they come from and why do their numbers continue to grow?

Life in the post Revolutionary War period in the United States was relatively simple. Most of the populace lived in rural areas and farmed for a livelihood. Schooling of any kind came at a high premium and money was scarce. As a result, only a few of the very promising young people received formal education. This effectively kept the slow learners and even the average learners out of the schools. Because of the life style and environment, the slow learner's weakness had less adverse effect on him. During the trade and commerce period, the need for more education be-

came felt and the academies came forth to meet that need. Now the promising students and the average students were being educated but still there were not enough schools nor teachers to provide for the slow learners. The lack of formal education however was beginning to exact a heavier penalty on the populace of a country, moving steadily into an era of industry and technology.

With the advent of the compulsory education laws during the latter part of the 19th century, and with their enforcement starting in the early part of the 20th century, the slow learners began, for the first time, to enter the public schools in numbers. By this time, quanities of well graded academic materials were becoming available to a group of better trained teachers. It became immediately obvious to the schools that many children were enrolling that were apparently incapable of learning as quickly as the majority of their school mates. The slow learners were now in school, right along with the average and above average students, but they were not very happy about this boon which was thrust upon them.

The work was generally too difficult for the slow learners, their grades were low or failing and their fellow students knew their plight. They

often repeated the first grade and one or more others in elementary school and by the time they had struggled through the 8th grade, they had reached the age of 16 and could legally quit, short of high school. Only the most determined slow learners managed to marginally complete high school by intensive study and much memorization. The penalties for not completing high school were becoming more and more severe and slow learners were most apt to find adult employment only in unskilled and low paying jobs.

In the early 1950s, the creation of the junior high school at the 7th, 8th and 9th grade levels brought the slow learners, for the first time, into the realm of secondary education. The new junior high schools, for the most part, were not prepared to cope with the slow learners and thus a major educational problem developed which is still very much with us today. Whether we, as teachers, like it or not, the slow learner must attend school for 12 years, no matter how little they may apparently learn, or how discouraged they may become, or to what extent their failures may be.

From a complete absence of slow learners in the colonial secondary schools to today's, 1 slow learner out of every 6 students, the magnitude of

the problem manifests itself. We can no longer hide our slow learners behind a plodding ox or deep in the forest with an axe. Moreover, there are many areas in which the slow learners can develop competence, and it is encumbent on all professional educators to prepare this special student group to grow into the best possible citizens who can contribute positively to the welfare of our society.

This paper seeks to examine and present methods best suited to assist the junior high school slow learner to acquire a selected basic mathematical skill.

How does one identify the slow learner who has just entered the 7th grade? A number of indicators can usually be found in the students' records. Such items as Intelligence Quotient, past performance in arithmetic, teacher recommendations, reading ability and results on standardized tests should be considered. Education professionals and psychologists generally agree that the slow learners have a mean I. Q. of 85 with limits established at 75 and 90. We are repeatedly warned against giving too much credence to I. Q. scores; however, since slow learning has been defined as a form of mental retardation, it seems valid to consider I. Q. as one factor. The

National Council of Teachers of Mathematics, as stated earlier, took the position that the slow learner ranks below the 30th percentile of the student population in mathematical achievement. The slow learners' records will almost invariably reflect low achievement in all subject areas, especially reading, dating back to his or her entry in school. It is possible that in attempting to identify slow learners, a teacher may sometime mistakenly include a low achieving student who is not actually a slow learner. This, however, is not too serious an error since in either case, the major concern of the teacher is to understand the students, to diagnose their learning problems and to make provisions for them in the classroom.

The basic characteristics and needs of the slow learners in junior high school are essentially the same as for all other adolescents. The chief distinction is that it is absolutely imperative that the teacher give special attention to the slow learners' needs inasmuch as these students have much more difficulty in making adjustments because of their limited mental abilities. It must be clearly understood that no amount of threats or rewards can transform a slow learner into a high level achiever. Even under effective educational conditions, the slow learners' maximum attainable

intellectual age is from 1 to 4 years behind that of an average learner. In its 35th Yearbook, the National Council of Teachers of Mathematics described a number of generally accepted characteristics and needs which must be understood and dealt with by anyone who would effectively teach the slow learner (17). There are no stereotype slow learners; they, like other students, have their own unique sets of strengths and weaknesses. The characteristics which we will examine represent those which are most often observed in the slow learner in various combinations.

A slow learner is likely to have a poor image of himself, both as a learner and as a person. He has encountered so many unsuccessful school experiences by the time he reaches the 7th grade, that he has little confidence in his ability to succeed at anything. He is caught in what has been called universal aversives, or conditions and consequences which most people tend to avoid. These include fear and anxiety (for example, of threatened failure, exposing his ignorance at the chalkboard in front of his peers or being sent to the principal); frustration (when information seems irrelevant or is presented too fast to assimilate); and humiliation and embarrassment (repeated failure, "special classes," and even the feeling of failure that is

engineered into the lower half of the grading curve). The slow learner has little chance of progressing so long as he considers himself a "loser". As the school attends to the mathematical deficiencies of the slow learner, whatever the matrix of causal factors and interrelationships may be, first priority should be given to reconstruction of his self-image.

Many slow learners are deficient in intellectual skills or cognitive functioning as measured by the predominantly verbal problems on intelligence tests. This apparent deficiency may be as much the fault of test technique as the students' weakness. However, some intellectual deficiencies often associated with the slow learner include a limited vocabulary; faulty grammar; inability to use abstract symbols; deficient formal speech patterns; restricted reading and listening comprehension; and a general lack of information concepts, and relational schemes. The slow learner is very apt to show weakness in classifying, ordering sequences of events, perceiving cause and effect relationship, generalizing, analyzing and solving abstract verbal thought sequence. His scholastic accomplishment is usually a year or more behind his average classmates and he exhibits a progressively deteriorating achievement pattern.

The achievement tests normally used to measure

students' progress are primarily head not hand oriented. These tests prize verbal skills and style over physical skills and style. Unfortunately the slow learner, whose learning style is usually one of physicalization, is again out of luck on another test. Tactile experiences with objects and events are indispensable to a learner who has no other effective input channel. The slow learner, to form concepts and work mathematical problems, needs the physical inputs provided by such manipulative materials as fraction pieces, Dienes blocks, geoboards, puzzles, games, machine calculators, and in fact all of the resources of a good mathematics laboratory (8). Even this more effective teaching approach cannot speed up the slow learners' rate of assimilation appreciably. A learning style that is physical is slow and the teacher must also understand that the slow learner tends to be cautious in his output because of his fear of failure. Pressuring or pushing a slow learner usually produces a slower learner.

Cultural environment is an important factor to all learners and cultural deficiencies can impair cognitive skills, damage affective functioning and impose between the learner and the school a barrier or conflict with which neither the school nor the student can cope. For the slow learner

who finds himself in a disadvantaged environment, life is doubly jeopardized. He is likely burdened with poverty and minority status and faces a high potential for economic, emotional and social disaster. Love of learning is certainly not a product of a slum home. Because of the authority stance of the head of most culturally deprived families, the children often have had little opportunity for intellectual interaction with adults. Furthermore, parents lacking an intellectual orientation probably cannot help their children with academic requirements, or instill in their children such virtues as promptness and orderliness or direct them toward long-range goals. Most teachers, on the other hand, come from a middle class culture, so different from the disadvantaged environment that often the teacher cannot actually imagine the true plight of the culturally deprived child. Such cultural conflict can seriously impair the teachers' effectiveness in working with children from so discordant an environment.

The slow learner often asserts that he values education but he doesn't like school. He is no doubt attacking the schools' curriculum as to its relevancy. Slow learners need to sense reality in the problems with which they are confronted, to sense at least occasionally that something

important has happened in the school mathematics or other subject setting. A curriculum based on lofty adult views, social pressures and disciplined logic may be valid to someone but certainly not to the slow learner; the school must be valid in his terms if he is to profit from it.

A slow learner often finds it difficult to defer immediate gratification in the interest of long range goals. His past experience with continuous failure or poor school performance leaves him pessimistic and wary about the future. The suggestion that a college degree and a good job lie ahead will not stir much enthusiasm within him. His goals are more nearly linked with this week's ball game, fixing up an old car or taking his girl to a movie. With the 7th grade slow learner, even a high school diploma "looks like a bad bet." In planning effective learning experiences for the slow learners, the teacher should consider well their need for short range recognition and early reward (13).

There are certain student or school skills which enable most children to learn effectively. Weaknesses in some of these, no doubt contribute to the slow learners' lack of educational success. The slow learner often fails to listen and pay attention. Some psychologists feel that an ability

to "tune out" certain audio stimuli is developed by individuals, particularly those whose home environments contain much noise of an irrelevant or irritating nature. Another weakness observed in many slow learners is a lack of persistance. Their attention span is short. A teacher's ability is truely taxed to discover methods or techniques which can capture and hold their attention for any appreciable period of time.

The slow learner is not usually reflective in problem solving and often is the first person in class to respond to a question. Even though in many instances his impulsive response is "the wrong answer" he appears to be seeking teacher and peer recognition for being first to respond. This characteristic is somewhat inconsistant for one who usually treads cautiously to avoid failure. Saylor and Alexander speak of the "hidden curriculum" as an unwritten modus operandi developed by most students to "coexist with," "get around" or "second guess" the regular curriculum (18). The use of the hidden curriculum is not really dishonest, rather it is a somewhat clever technique through which the student can gain maximum credit by exploiting loopholes in the school system. The slow learner who gives a quick response may actually feel that he has a "50-50 chance" of guessing right

and is therefore willing to take the calculated risk. Because of his intellectual difficulties, the slow learner probably needs the hidden curriculum more than any other student in school.

Initiative is another school virtue lacking in the slow learner. Their past offerings have so often been faulty that they are not eager to expose themselves in a nonsupportive or threatening situation. Most slow learners have a deficient sense of time, order and sequence and an ability to properly cope with sequential events. As a result, they generally have difficulty getting organized or in their language "getting it all together." Lost pencils, forgotten notebooks, misplaced or unfinished homework are typical examples of their disorganization.

In the absence of scholastic recognition and other sources of intellectual reward and reinforcement, the slow learners, in many instances rate their level of success in terms of their relationships with peers. They strive for strong peer identification and group support even though their social aplomb often deprives them of membership with the "in group." This is especially true for the slow learners who come from a disadvantaged environment. Outside of school and freed from the teacher ordered classes and chaffing constraints,

the slow learner often becomes a different person. In a setting which permits him to call the plays, he may exhibit aggressive, physical leadership and may in fact, realize some of the prestige he so sorely misses in the classroom. In addition to peer recognition, the slow learner needs approval and appreciation from those adults whom he considers significant. For the 7th grader, these would consist of certain authority figures who possess either the skills or the power that the adolescent values. The slow learner will tend to identify with one or more of the above figures and attempt to adopt behaviors and skills that he believes will make him similar to them. One of the most significant contingencies in a class of slow learners is that one of them will find in the teacher an adult model with whom he or she can identify and from whom he or she can catch a positive attitude toward mathematics. The establishment of a positive identity relationship between a teacher and a slow learner is probably the most valuable single accomplishment toward the conduct of any successful learning experience.

Finally in the list of characteristics of the slow learner, it is necessary to recognize the importance of differences associated with the sex of the student. It makes a great deal of difference

whether the slow learner is a boy or girl, especially when the teacher is searching for strategies and techniques appropriate for the student. Richard Schulz states "Whether inherent traits or cultural imprints, sex related differences have been observed in learning styles, role expectancies, sensitivities, aggressive tendencies, toleration of femininity or masculinity, and response to authority"(17). Certain school subjects are considered to be masculine, such as science and mathematics while others such as language and social studies are more related to girls. In any event, a great deal more scientific research must be made to fully understand the sex differences as they relate to the slow learner. The fact that from 3 to 10 times as many slow learner boys have learning and behavior disorders than slow learner girls should provide sufficient cause for us to give priority to the study of this particular area.

An attempt has been made thus far to examine the slow learner in the public secondary schools. The current situation has been described with regards to the education of slow learners and they have been defined in comparison with other categories of low achievers. Their numerical increase in our schools has been examined by tracing them through a general history and changing concepts

of the American secondary education system. An explanation has been given regarding the identification of slow learners and finally, a description of the characteristics and special needs of the slow learners in the junior high schools has been presented. The remainder of the paper will be devoted to the development of a teaching plan aimed at providing a meaningful and relevant learning experience for slow learners in junior high school mathematics.

There is a general agreement among junior high school mathematics teachers and counselors that slow learners have more difficulty in dealing with fractions than any other basic area. (1) (9) (20) Building understanding and skills in this area is a most challenging problem, since there are a greater variety of error patterns revealed by students working with fractions than in any other area of arithmetic.(6) I have chosen for this project to research and present selected methods and techniques for instructing 7th grade slow learner mathematics students to add and subtract non-decimal fractions. This instruction will constitute a sub-unit of the work normally devoted to the overall study of fractions.

The general instructional objective of this project is to prepare the students for living successfully in today's society by providing them with a

working knowledge of an important area of basic mathematics. In pursuing this objective, it is also strongly desired that a better understanding and appreciation for other areas of mathematics can be promoted with each student. The specific objectives of the instruction are to prepare the students to accomplish the following:

1. Addition

   a. Given 10 addition problems of 2 fractions with like denominators, all students will be able to add these in 15 minutes with 70+ per cent accuracy.

   b. Given 10 addition problems of 2 fractions or mixed numbers with like denominators, 2/3 of the students will be able to add these in 15 minutes with 70+ per cent accuracy.

   c. Given 10 addition problems of 2 fractions or mixed numbers with unlike denominators, 1/3 of the students will be able to add these in 20 minutes with 70+ per cent accuracy.

2. Subtraction

   a. Given 10 subtraction problems of 2 fractions with like denominators, all students will be able to subtract these in 15 minutes with 70+ per cent accuracy.

   b. Given 10 subtraction problems of 2 fractions or mixed numbers with like denominators (may involve regrouping), 2/3 of the students will be able to subtract these in 15 minutes with 70+ per cent accuracy.

   c. Given 10 subtraction problems of 2 fractions or mixed numbers unlike denominators (may involve regrouping), 1/3 of the students will be able to solve these in 20 minutes with 70+ per cent accuracy.

The instruction of this sub-unit is designed for the lowest achieving students in 7th grade mathematics and participation in it should be limited to those students whose demonstrated mathematics achievement ranks below the 30th percentile. Teacher qualifications for this instruction are very important with regard to both knowledge of subject matter and educator professionalism. The teacher should be an experienced one who relates well with students and recognizes each of them as an important human being. He or she must be patient, firm and fair and must be consistent in dealing with students. He or she must be innovative, willing to try new methods and most of all must believe in the worth and potential success of the instruction. He or she should possess those 3 most valuable teacher qualities; common sense, a sense of humor and dignity. (14) An older teacher would probably be aware of more practical applications of mathematics to enrich the instruction.than would a younger teacher; however, the latter would likely relate better with the students. In either case, the teacher must be a dedicated one who is willing to make himself or herself available to students for additional help and counseling. (8)

The study of fractions does not occur at the beginning of a course in general mathematics. Whether at the elementary level, or as in this instance, the junior high school level, a prerequisite foundation in numbers knowledge precedes the introduction of fractions. This numbers knowledge normally includes a basic understanding of the concept of natural and whole numbers and the operations of addition, subtraction, multiplication and division on whole numbers. For 7th grade students, I feel it reasonable to assume that they are already acquainted with the idea of a fraction, and that this idea has been well nurtured by seeing and working with concrete examples of 1/3 of something, 1/2 of something, and so on. I shall therefore plan this instruction based on the assumption that the students have progressed through the above mentioned preparatory foundation and possess some minimum competence in those areas.

The content of this sub-unit of instruction includes the following topics and estimated schedules:

1. Description of fractions (1 period)
2. Renaming fractions (2 periods)
3. Adding fractions with like denominators. (1½ periods)
4. Subtracting fractions with like denominators (1½ periods)

5. Converting fractions with unlike denominators to fractions with common denominators (3 periods)

6. Reduce common denominators to lowest terms (1 period)

7. Adding fractions with unlike denominators (2 periods)

8. Subtracting fractions with unlike denominators (2 periods)

9. Mixed numbers (1 period)

10. Adding mixed numbers (2 periods)

11. Subtracting mixed numbers (3 periods)

The resources required for this instruction are very similar to those employed in the mathematics laboratory courses. A single classroom equipped with special trapezoidal tables, student chairs and carrels will be utilized and a variety of audio-visual equipment and selected teaching aids and materials will be required. In addition to the standard chalk boards and bulletin boards, there will be a requirement for an overhead and 16mm movie projector, projection stand, projection screen, individual filmstrip viewers, and a filmstrip projector. One para-professional assistant and one student aide (9th grade high achieving mathematics student) are required to support the teacher during classroom periods.

It is not anticipated that the students will require a text book during this instruction; however, the teacher should use one or more good text book

sources to obtain special problem exercises. Bernsteins' and Wells' "Trouble Shooting Mathematical Skills" is a State adopted text book which provides excellent coverage for the area of fractions. (6)

Special materials such as "Individualizing Mathematics, Skills and Patterns, Fractions, Addition and Subtraction" by Foley, Smith and Basten can assist the teacher greatly by providing the more competent students a ready made and complete "do it yourself" course in fractions. (12) Movies such as "Fractions: Finding a Common Denominator"- 13 mins., color, are highly desirable to augment the teacher's instruction and the 8 filmstrip series "Understanding Fractions" can be especially helpful for students having difficulty with specific topics. The time required for instructing this sub-unit is 20 class periods or 4 weeks.

In selecting an effective strategy for teaching this sub-unit, it is necessary to consider the general nature of the students and the learning goals to be achieved. With the slow learners in junior high school, attitude toward the subject also constitutes an important factor. Negative attitudes of fear, dislike, frustration and outright rejection are often firmly fixed among 7th grade slow learners. They respond best to a psysicalization approach to learning, presented in short

independent topics with favorable recognition for positive students' efforts. The strategy for this instruction will therefore employ concrete examples to the maximum extent possible and will avoid the use of abstract methods and complex algorithms. The major emphasis throughout the instruction will be to keep it interesting, keep it meaningful, and keep it attainable.

Teaching techniques are vital when working with slow learners and the teacher-student relationship is paramount. Willard Abraham has summarized the slow learners' critical needs as the 3 A s, acceptance, affection, and achievement. (19) The fulfilling of these needs must be central in the conduct of the instruction. The teacher must deal with each student as an individual and make him or her feel that they are a worthwhile member of the class. Speaking to and making eye contact with each student daily should be a goal for the teacher and every effort should be made not to embarrass a student in front of his classmates. Rebuilding the slow learners' self image is all important. It is most necessary that the students experience success. Developing situations and exercises hard enough to challenge their abilities, yet easy enough for them to successfully accomplish is indeed a difficult task for the teacher.

Consistency and routine are important features

to be incorporated in this instruction. Slow learners need to know exactly what is to be expected of them and when. They function better and feel more secure in familiar surroundings and in established routines regarding both schedule and procedure. This need for classroom stability, however, should not preclude the teacher varying the pace, at times with surprises to avoid boredom.

Techniques for dealing with misconduct in the classroom are quite important when teaching slow learners. The self image problem which plagues most of these students poses a serious dilemma to the teacher. The philosophy of "praise the good and ignore the bad" is not always sufficient to maintain adequate classroom decorum and at times more stringent controls are required.

An interesting technique was observed at Jefferson Junior High School.(3) At the beginning of a 6 weeks grading period, each student is given 100 points of credits and told that this will constitute 10 per cent of his or her unit grade. Students are also advised that breaches in conduct will result in losses of points in amounts specifically established or at the teacher's discretion in special instances. At Hoover Junior High School, each student has a card form on which the teacher stamps credit symbols at the end of

each class period. (10) If the student has conducted himself or herself in accordance with standards posted in the classroom, they earn 4 credits per class; if not, then some or all of that day's credits are denied. On alternate Fridays, the school has "exchange day" or a small carnival at which students can cash in their credits for attending movies or other rewards. Both of the above described techniques appear to be working successfully.

Fawcett and Cummins stated the belief that "one really expresses his philosophy of teaching through his methodology."(11) Many improvements have been made in teaching methods since the school master tapped cadance with a ruler while his pupils recited their tables. Student centered methods have replaced the teacher centered ones to meet the varying needs of the individual. Today's teacher has a number of proven methods from which to choose in establishing an effective learning situation for his or her particular student group. For the content of this sub-unit being taught to 7th grade slow learners, I believe the laboratory approach offers the most promising single method.

In the laboratory approach, students experiment with concrete objects to develop mathematical ideas. They also use individualized mathematics

materials and exploratory numerical activities to help develop understanding of later desired abstract ideas. For slow learners, the laboratory approach is practically indispensable. Nearly all our ideas of things are gained from their "sensible effects" (sight, mind, taste) and for the slow learner this means, for effective learning, contact with concrete things rather than reliance on abstractions.

To increase the understanding and appreciation of the instruction, I would additionally employ the heuristic or discovery method. This student centered approach aims at causing the pupils to develop some mathematical truths of their own. The teacher through the use of leading questions guides the students to be creative and to discover ideas and generalizations by themselves. Although this method is slower and requires more work on the teacher's part, it promotes much better understanding and subject interest in the students.

The first period of this instruction would consist of a short introduction of the subject of fractions and a brief explanation of how the unit contents is to be handled. The students then will be provided with an assortment of objects which have been divided into fractional parts to provide a clear understanding of the description of fractions. The last half of the period will be utilized for

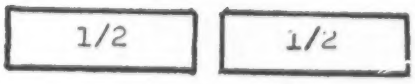
administering a pre-test to the students.

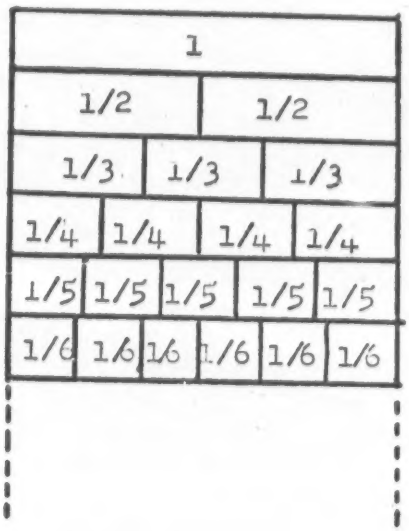
Based on the results of the pre-test, groups of students with like capabilities will be guided through selected learning situations which have been designed for their particular level of proficiency. Diagnostic evaluation will then be continuous and instructional adjustments will be effected as required to deal with specific group or individual weaknesses.

A careful and slow graduation of the mathematical difficulty of the material studied is essential. The knowledge must be built up in such a manner that the students gain confidence in their understanding and are not tempted to guess at answers. Guessing and meaningless trial and error search are two solution methods which most slow learners have come to use extensively; hopefully we can reduce or remove this habit. If the students do not correctly perform an exercise on their first attempt, the teacher should explain their mistakes to them and have them rework the paper. Successful completion matters much more than quantity of material covered, and successful student materials should be exhibited to provide a feeling of accomplishment to its author.(20) Some homework should be required, primarily to dispel student feelings that the course is low level

and for second-class citizens. Many slow learners will openly label themselves as "dumb" and it is encumbent on a good teacher to eliminate this attitude if at all possible.

In the study of fractions, the topic of common denominators is generally considered the most difficult for students to master.(1) Fawcett and Cummins have proposed an interesting, and I believe effective approach to teach the addition of unlike fractions.(11) Each student is given a chart arranged as in the figure below along with matching cards to represent 1/2, 1/3, 1/4..... A 1/2 card placed beside another 1/2 card fills the 1 - space.





Now the teacher is ready for questions.

a. Can anyone use his cards to show us 1/2 + 1/3?

Now every student can do this and he experiences 1/2 + 1/3 both by sight and by manipulation. Many

students have never "seen" 1/2 + 1/3 even with their eyes but were taught a meaningless rigmarole to add these fractions.

b. Can you find another name for 1/2 + 1/3 by the use of the cards and the charts? The students will discover that 1/2 + 1/3 has 5/6 for another name.

c. c. Let's try 1/3 + 1/4. The students find by the use of physical devices that another name for 1/3 + 1/4 is 7/12.

The teacher now asks for some other sums and invites the students to see if they can devise a method of operation on the numerals themselves to get the sum without the use of the cards. What excitement there is when a student suggests adding the two denominators to arrive at the numerator of the sum and multiplying them for the denominator of the sum. The teacher should not say "Right!" This is the inductive process at work and the teacher should reply "Perhaps! Let's try some more!" If the algorithm seems to work, then this may be called Harry's or Mary's con-

jecture until such time as a rationale is suggested to support its proof. Indeed, perhaps tomorrow, a student may say "We should have known that 1/2 + 1/3 is 5/6, for from the charts 1/2 has another name 3/6; 1/3 has the other name 2/6, and 3/6 + 2/6 equals 5/6." This is an acceptable rationale for slow learners in fractions and the teacher should compliment the class for its achievement. The charts and cards can be easily modified to accomodate mixed number answers, permitting the teacher again to guide the class through discovery to effective and meaningful learning.

The following lesson plan for one class period of this instruction is suggested:

Course: General Mathematics

Date: Tuesday, October 15, 1974

Unit: Fractions (addition)

Objective: To teach the students the addition of proper fractions with like denominators.

Period Schedule:

5 mins: While student aides distribute work folders, start the period with a game to capture the students' attention; "What's my Rule?" is a good starter. Explain to the class that you have a secret operation which you will use on numbers they select and that the first student who discovers your secret will be rewarded. Ask for a

number between 0 and 100. Someone says, "22", you answer, "50". Someone says, "9", you answer, "24". Continue to play until someone discovers that your secret operation is adding 3 to their number and doubling the sum. The reward can be a little piece of candy or any small item; the important prize was "the winning".

15 mins: Explain the idea of adding like fractions. This includes practical reasons for doing so. Use chalk board to illustrate fraction models and number lines to enhance the students' understanding.

15 mins: Give class written exercise in adding pairs of fractions with like denominators (10 problems), assist students who may have difficulties.

10 mins. Review exercise by working problems on the chalk board and answering questions. Exercise papers will be collected and graded by student aides, who will bring significant errors to teacher's attention.

5 mins: Class reviews words and names associated with fractions and teacher assigns 5 problems to be worked at home.

Student evaluation for this instruction should be built on a continuous diagnosis of each individual's needs and learning deficiencies and a

constant appraisal of his growth. (8) The emphasis, as stated earlier, should be on each student's progress relative to his own performance, rather than to the performance of the class as a whole. This is generally accomplished through the use of pretests for determining the pupils' initial level, followed by periodic achievement testing during the course of instruction. Slow learners often "go blank" when confronted with a formal test and are unable to accomplish tasks which they have previously successfully performed under less pressured conditions. It is therefore recommended that all testing be conducted as informally and routinely as possible. Since most slow learners are very poor readers, test instructions and test questions should contain an absolute minimum of written content and the teacher whould insure that all students clearly understand what they are asked to do. It is important not to place too much emphasis on achievement testing, in evaluating the slow learners, but to consider all relevant criteria. Factors such as attitude, interest, effort, and overall progress should be considered. In determining unit grades, approximately 25 per cent should be based on achievement test scores and growth quotient, 25 per cent on observable behavior, 25 per cent on estimated progress, and 25 per cent on class work,

projects, work sheets and other special activities. It is imperative that the students know from the beginning of the instruction what grading system is going to be used and that the teacher can justify each assigned grade within the framework of that system. The teacher should not forget that student motivation is of prime importance in this instruction and that nothing succeeds like success. It is therefore encumbent on the teacher to conduct this sub-unit with sufficient skill and efficiency to permit as many students as possible. to complete the unit with a self image building grade.

It is painfully clear that a sizable per centage of the students in our public school system are unable to keep pace, academically with most of their fellow students. For them, "the slow learners'" school is usually just one demoralizing experience after another until they finally abandon it, ungraduated and convinced that they are born losers. In prior years, little progress was made by the school system to alleviate this unfortunate situation but happily this is no longer true. Professional educators, psychologists, sociologists and many related specialists have attacked this problem with intense resolve and gratifying results are being realized all over the world. Based

on a much clearer understanding of the nature of slow learners and their special needs, many state and county boards of education in this country have taken significant measures to provide more effective education for these students. Specially trained teachers and counselors, special curricula, special facilities and mountains of special teaching equipment, aids and materials have been made available. All that remains needed is years and years of dedicated effort by teachers who are capable enough and who care enough to guide slow learners through a meaningful school program and into adulthood, not only feeling more valuable but being more valuable.

More research, of course is needed to further improve the education for slow learners, particularly in the social and cultural areas. In addition, it is my sincere belief that the secondary schools must make major changes to meet the job preparation requirements of the slow learners as well as all the other students who will not become college trained. The token vocational programs found in many high schools today serve chiefly as hiding places for low achievers waiting to become old enough to "drop out". These programs greatly expanded and coordinated with the academic programs of the lower grades could prepare American youth for a quality of life unsurpassed on this planet.

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